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|  | **Unit 1: Biochemistry** | | | | | | | |
| Name: | | Start Date: | | | 08/28/17 |  |  |  |
|  | | Test 1 Date: | | | 09/25/17 |  |  |  |
| Period: (Honors) | | Teacher: Ms. Jost | | | |  |  |  |
|  | |  |  |  |  |  |  |  |
| **BIOCHEMISTRY** | | Submitted | Resubmit | Correct | Evidence of Learning | Page # | Date | Sign-Off |
| **Objective 1:** Compare the structures & functions of the major biological molecules, organic and inorganic, as related to the survival of organisms | |  |  |  | **Catalyst: What did you eat for breakfast?**  **Activity: Meal Prep**  **HW: Breakfast Research & Reflection** | 4 |  |  |
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**Unit 1: BioChemistry**

Start Date: 08/28/17

Test 1 Date: 09/25/17

**Objective 1:** Compare the structures and functions of the major biological molecules, organic and inorganic, as related to the survival of organisms.

*Essential Question:* What are the subunits and functions of the four major groups of organic molecules?

*Essential Question:* What are the properties of water?

*“I Can” Statements:*

* Compare and contrast the four major organic macromolecule groups in terms of:
  + The formative elements
  + The formative subunits (monomers)
  + Functions within the cell/organism
  + Where found in the diet (food sources)
* Describe the major properties of water and explain the importance of these properties in the context of sustaining life:
  + Universal solvent
  + High specific heat
  + Adhesion and cohesion
  + Capillary action
  + Density

**Objective 2:**  Explain how enzymes act as catalysts for biological reactions.

*Essential Question:* How and why do enzymes catalyze biological reactions?

*“I Can” Statements:*

* Demonstrate the link between shape and function as it relates to an enzyme-substrate complex, as well as the effects of environmental factors (temperature, pH) on enzyme efficiency
* Develop a cause-and-effect model for specificity of enzymes

**Vocabulary**

* Activation Energy
* Adhesion
* Amino Acid
* Capillary Action
* Carbohydrate
* Catalyst
* Cohesion
* Denature
* DNA
* Density
* Enzyme
* Fatty Acid
* Hormone
* Inorganic
* Lipid
* Macromolecule
* Monomer
* Monosaccharide
* Nucleic Acid
* Nucleotide
* Organic
* Peptide Bond
* Polarity
* Polymer
* Polysaccharide
* Product
* Protein
* Reactant
* RNA
* Solvent
* Solute
* Substrate

**Notes: Biomolecules (Organic) Organic=**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Biomolecule** | **Found in** | **Elements & Subunit (Monomer)** | **Structure** | **Functions** | **Examples** |
| Carbohydrates |  | Elements:  Monomer: |  |  |  |
| Lipid |  | Elements:  Monomer: |  |  |  |
| Proteins |  | Elements:  Monomer: |  |  |  |
| Nucleic Acids |  | Elements:  Monomer: |  |  |  |

**Catalyst: What did you have for breakfast? Please be specific as possible in your description, include how much of each food you had.**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Homework**

Fill out the nutrition chart for your breakfast. You may read the nutrition label of the product or use the following websites as resources: <https://ndb.nal.usda.gov/ndb/search>

<http://nutritiondata.self.com/>

(Add line below the chart if needed)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of Food** | **Serving Size** | **Servings per Container** | **Calories per serving?** | **Grams of fat per serving?** | **Grams of protein per serving?** | **Grams of carbohydrates per serving?** | **Most prevalent: carbohydrates, lipids, or protein?** |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
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**Reflection: Are you eating enough for breakfast? Are you eating the right stuff for breakfast? Defend your answer.**

**Catalyst: Breakfast Counsel**

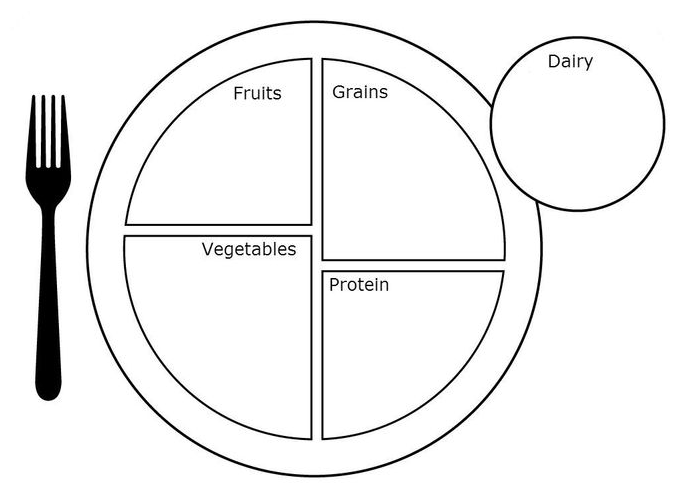
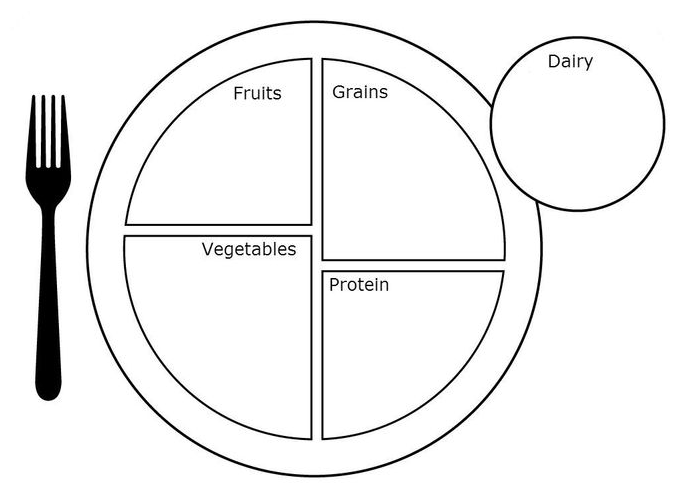
**Based on what you know about nutrition and biomolecules, provide advice for the following two students as to what they should be eating for breakfast.**

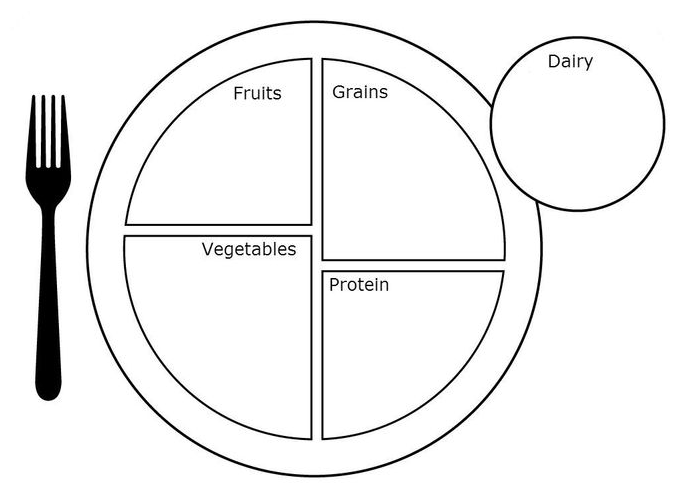
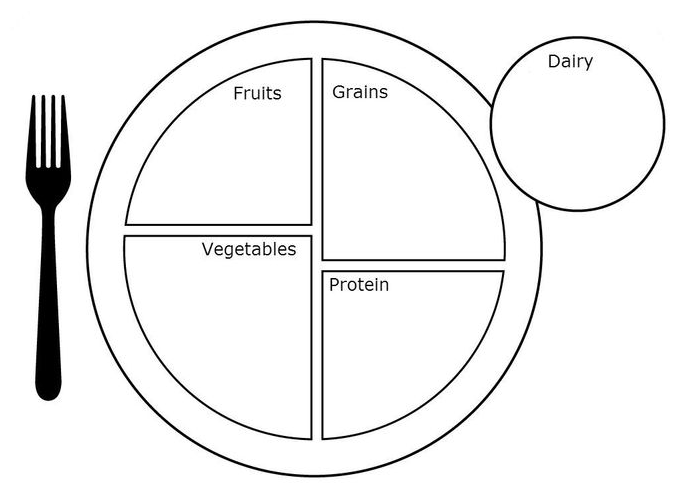
1. Jordan is an all-star athlete on the WLPCS basketball team. At 6’6 his body needs a lot of fuel and his coach keeps encouraging him to bulk up a little to be more competitive in the paint. Jordan typically eats a Poptart for breakfast and has recently begun eating two every morning thinking that the extra calories is all he needs to help him gain more muscle. Why is this not the best breakfast for Jordan? What should he be eating?

2. Sarah is simply not a morning person and always snoozes her alarm multiple times, often making her late to school. Since she is always running late she rarely has time for breakfast. Lately, Sarah has been really struggling in her alpha period, she often feels irritable and is struggling to understand the material. Why is it important for her to eat breakfast? What should she be eating for breakfast? (Brainstorm some foods she can easily grab on the go and eat on her way to class.

**Activity: Meal Prep**

You and your team are in charge of designing a healthy, balanced meal plan for 11th grade students. With your team you will design a sample menu for a day that includes a balanced portion of the 5 major food groups: Fruit, Vegetables, Protein, Dairy, Grains. After you have completed your menu, count how many servings\* of each food group you have and fill in the chart at the bottom of the page. Use your own diet and eating habits to inspire your menu, but remember you can only eat so much in one sitting so include no more than 4 items per meal.

******Breakfast Lunch**

**Snack Dinner**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Food Group | Fruits | Vegetables | Protein | Grains | Dairy |
| Total Daily Serving |  |  |  |  |  |

\*serving size depends on the items but for this exercise assume 1 serving= 1 cup, oz, or slice

**Activity: Meal Plan**

Now that you’ve made your meal plan, let’s see how it compares to the recommended serving as published by the United State Department of Agriculture (USDA).





**Vegetables**

**Protein**

**Grains**

**Fruits**

**Dairy**

**Extras (Sweets, Fats, ect.)**

Recommended Daily Calorie Intake:

Recommended Daily Calorie Intake:

Reflection

1. Based on this information, how does your group’s meal plan compare? What food do you need to include more of? Less of?

2. Thinking about your own eating habits, is there anything you need to do to make sure your diet is more balanced?

Lab: Food Labels Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period: \_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 1:** Compare the structures and functions of the major biological molecules, organic and inorganic, as related to the survival of organisms.

**Background Information**

In 1992, the United States Department of Agriculture created the Food Pyramid as a way of visually representing recommended portions of each food group. This pyramid was modified in 2005. The current pyramid divides foods into six categories: grains, vegetables, fruits, milk, meats & beans, and oils & sweets. The USDA recommends that an adult consumes daily 6 oz. of grains, 2 ½ cups of vegetables, 2 cups of fruit, 3 cups of milk, and 5 ½ oz. of meat & beans. Oils & sweets should be consumed in moderation.

What nutrients are present in each of the six food groups? In this laboratory activity, you are going to investigate the nutrients present in each food group.

Begin this activity by reading the article titled “Nutrition Fact Sheet: Clearing Up Calorie Confusion” published by the American Dietetic Association.

**Article: Nutrition Fact Sheet: Clearing Up Calorie Confusion**

With so many different messages about how to lose weight, consumers are most interested in the most successful solutions. The key to any successful, healthy weight-loss strategy comes down to managing calories – making sure you eat fewer and/or burn more. But, since calorie counting can be challenging for some of us, some simple tips can make it a bit easier.

It’s all about calorie balance. That means if you eat more calories than your body uses, they will be stored as fat. One pound of body fat is equal to 3,500 calories. For example, eating 500 fewer calories per day would result in losing one pound per week. Of course, every “body” is different, so you may find that your weight loss can vary from week to week.

*Portion Management*

To keep calories in check, be mindful about the amount of food you eat on each occasion at breakfast, lunch, dinner, and snacks. You may still enjoy your favorite foods, just in moderation. To do this, you need to be aware of portion sizes and choose the amount that’s right for you.

Research suggests that we eat in “units,” such as a sandwich, a plate of food, or a slice of pizza – but today’s units come in varying sizes. Of course, the bigger the portion, the more calories you’re eating – and this is where the nutrition label can be a useful tool. Use the label to determine the amount of calories and nutrients per serving so you can keep track of how much you’re eating. When dining out, some tips to managing portions are:

* Request a half order of an entrée. Have it served on a salad plate rather than a large dinner plate.
* Share an entrée with a friend.
* Ask about child-sized portions.
* Get a “to-go” box when you are served and put half the meal into it before you start to eat.
* Order an appetizer as an entrée.

*Go Ahead and Snack*

It’s a smart strategy to incorporate your favorite “fun foods,” just do so in moderation. Divide larger packages into smaller portions or choose foods in pre-proportioned single-serving packages. Look for snacks such as fat-free yogurt, fruit cups, crackers, reduced fat cookies or cheese that provide about 100 to 150 calories per package.

*Jot it Down*

To get an idea of how much you’re eating, try keeping a food diary for a few days. Jot down everything you eat and drink, including the portion size. This will help you spot those “hidden” calories that seem to sneak in.

People tend to underestimate how much they eat. To help you get a perspective on your portion sizes, read food labels to see what is listed as the serving size. To get an idea of what serving sizes look like, use measuring cups to portion out one serving. Do this a few times for foods you eat frequently and soon you’ll be able to gauge on your own how much you are eating by visual cues.

*Portion Control is in Your Hands*

Judging serving size is a learned skill. For a quick estimate of portion sizes, here are some helpful reminders:

|  |  |  |
| --- | --- | --- |
| **Food** | **Serving Size** | **About the size of…** |
| Meat, Poultry, Fish | 2 – 3 ounces | Deck of cards or palm of your hand |
| Pasta, Rice | ½ cup | Small computer mouse or the size of your fist |
| Cooked vegetables | ½ cup | Small computer mouse |
| Fruit | ½ cup | Small computer mouse or a medium apple, pear, or orange |
| Cheese | 1 ½ ounces hard cheese | C battery or your thumb |

|  |  |
| --- | --- |
| **Easy Ways to Burn 100 Calories –** *Based on a 150 pound person* | |
| **Activity** | **Minutes needed** |
| Gardening | 20 |
| Washing the car | 20 |
| Walking the dog | 20 |
| Pushing a stroller | 20 |
| Bicycling | 25 |
| Aerobic dance | 15 |
| Ice skating, Roller skating | 15 |
| Jogging | 15 |

*Calorie Balance*

Research suggests that subtracting 100 calories a day could go a long way in helping you manage your weight. There are many ways to burn 100 calories through physical activities. It can be as simple as walking your dog around the neighborhood, gardening, or kicking around a soccer ball. Here are some tips for making fitness fun.

*Bottom Line*

Make sure your calories count by choosing a wide variety of healthful foods each day. Be sure to get the nutrients you need by including whole grains; fruits and vegetables; lean meat; low-fat or fat-free dairy foods; and moderate portions of your favorite snacks. Add regular   
physical activity and you’re on your way to a healthy and   
balanced lifestyle.

**PreLab Questions:**

1. Why does the body store fat?   
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How many calories are in 1 pound of body fat?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What are the recommended serving sizes for meat? Pasta or rice? Fruit?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. The American Dietetic Association thinks that Americans are suffering from an “obesity epidemic.”
   1. What evidence do you have that supports this assertion?   
      \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. What do you think has caused/is causing this problem? Justify your response.   
      \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Propose two solutions to this problem. Justify your solutions in terms of practicality and whether or not the solution could be implemented.   
      \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Food Label Analysis Directions:**

Choose 5 empty food packages and study their labels. Make sure that you find foods that are good sources of protein, lipids, and carbohydrates. Complete the following table about their nutritional information:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of Food** | **Serving Size** | **Servings per Container** | **Calories per serving?** | **Grams of fat per serving?** | **Grams of protein per serving?** | **Grams of carbohydrates per serving?** | **Most prevalent: carbohydrates, lipids, or protein?** |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

**Food Label Analysis Questions:**

1. Of the foods you tested, which was highest in carbohydrates? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

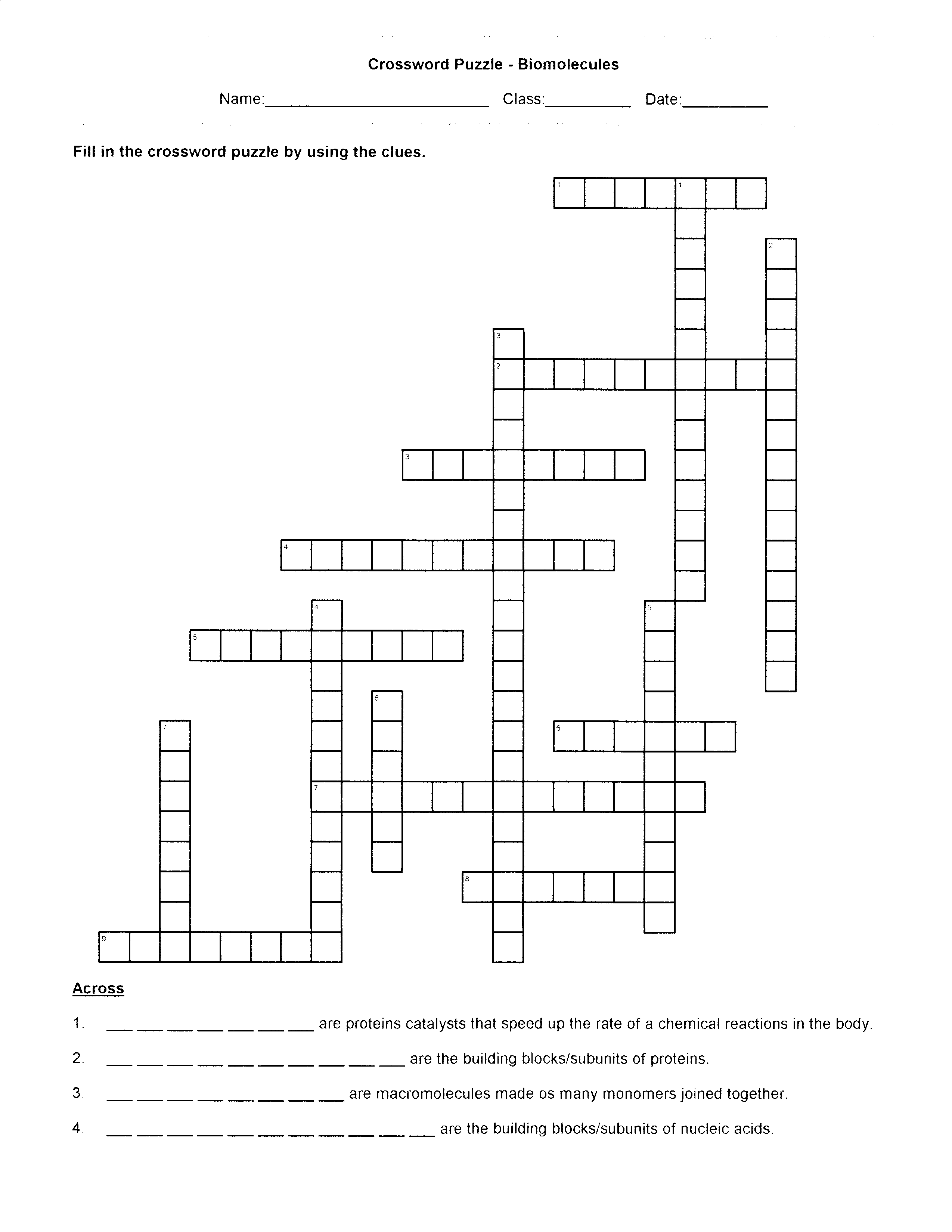
List another food you think would be high in carbohydrates. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

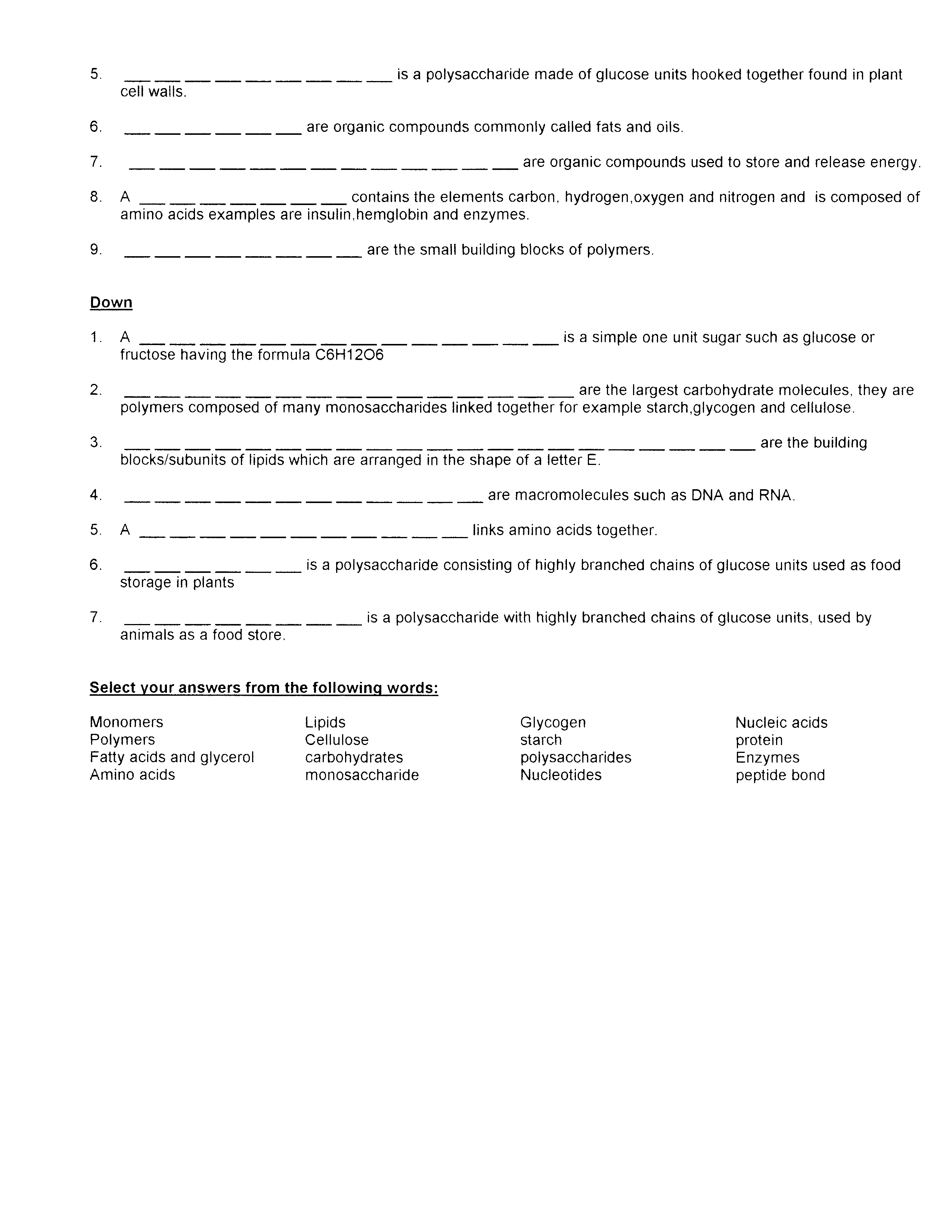
1. Of the foods you tested, which was highest in protein? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

List another food you think would be high in protein. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Of the foods you tested, which was highest in lipids? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

List another food you think would be high in lipids. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_





**Lab: Biomolecules Indicator Food Lab**

Each chemical test described below uses a chemical indicator, distilled water, and a selected substance. If the test is positive, a significant color change will occur due to the indicator coming into contact with the specified biomolecule.

*Chemical Indicators:*

1. Biuret’s Reagent
2. Iodine solution
3. Brown paper towel test
4. Benedict’s solution

*Test Substances:*

1. Lipid (cooking oil)
2. Protein (protein powder)
3. Complex Carbohydrate (starch)
4. Simple Carbohydrate (glucose)

*General Lab Procedure:*

1. Assign each person in your group to one of the following roles. Record their names on the lines:
   1. Responsible for obtaining supplies and directing the group’s activity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Responsible for adding the test substances to the test tubes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Responsible for adding the indicator solutions to the test tubes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. Responsible for making observations and recording data in the data table \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. Responsible for cleaning up and washing the test tubes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Obtain test tubes for each substance being tested, one for a control and the others for testing the substance. Place these test tubes in a test tube rack.
   1. Label the 1st test tube “oil.”
   2. Label the 2nd test tube “protein.”
   3. Label the 3rd test tube “starch.”
   4. Label the 4th test tube “glucose.”
   5. Label the 5th test tube “water.”

**Draw a simple sketch of your lab set up:**

***Part A: Biuret’s Reagent test***

***\*\*Note\*\**** Biuret’s reagent is caustic to the skin and clothing. If Biuret is spilled, rinse with soap and water and tell your teacher immediately.

1. Obtain chemical splash goggles and put them on.
2. Choose one person from your group to handle the Biuret’s reagent. That person must obtain gloves from your teacher.
3. Look at the five test tubes in the test tube rack in front of you. Make sure to only pick up one test tube at a time and to place it back in the correct place before handling another test tube.
4. Using a clean pipette, add 1.0 mL of vegetable oil to the test tube labeled “oil.”
5. Using a clean pipette, add 1.0 mL of protein solution to the test tube labeled “protein.”
6. Using a clean pipette, add 1.0 mL of starch solution to the test tube labeled “starch.”
7. Using a clean pipette, add 1.0 mL of glucose solution to the test tube labeled “glucose.”
8. Using a clean pipette, add 1.0 mL of distilled water to the test tube labeled “water.”
9. Add 10 drops of Biuret’s reagent to each test tube. Gently shake each test tube to mix the solutions.
10. Record your observations in the data table below.
11. Dispose of the solutions by flushing them down the drain with copious amounts of water.
12. Use a test tube brush and soapy water to clean the five test tubes and rinse with clean water. Use a paper towel to dry the test tubes as best you can.

***Part B: Paper Towel Test***

1. Obtain a piece of brown paper towel approximately square in shape.
2. Draw five non-overlapping circles on the paper towel. Label each circle with one of the test substances: Oil, Protein, Starch, Glucose, Water.
3. Using a clean pipette, add 1 drop of vegetable oil to the circle labeled “oil.”
4. Using a clean pipette, add 1 drop of protein solution to the circle labeled “protein.”
5. Using a clean pipette, add 1 drop of starch solution to the circle labeled “starch.”
6. Using a clean pipette, add 1 drop of glucose solution to the circle labeled “glucose.”
7. Using a clean pipette, add 1 drop of distilled water to the circle labeled “water.”
8. Hold the paper towel up to the light once the solutions have soaked into the paper towel. Observe whether or not the paper towel is transparent (see-through) or not. Record your observations in the data table below.
9. Dispose of the paper towel in the rubbish bin.

***Part C: Lugol’s Iodine Test***

***\*\*Note\*\**** Iodine can stain skin and clothing. If iodine is spilled, rinse with soap and water and tell your teacher immediately.

1. Look at the five test tubes in the test tube rack in front of you. Make sure to only pick up one test tube at a time and to place it back in the correct place before handling another test tube.
2. Using a clean pipette, add 1.0 mL of vegetable oil to the test tube labeled “oil.”
3. Using a clean pipette, add 1.0 mL of protein solution to the test tube labeled “protein.”
4. Using a clean pipette, add 1.0 mL of starch solution to the test tube labeled “starch.”
5. Using a clean pipette, add 1.0 mL of glucose solution to the test tube labeled “glucose.”
6. Using a clean pipette, add 1.0 mL of distilled water to the test tube labeled “water.”
7. Add 3 drops of Lugol’s Iodine solution to each test tube. Gently shake each test tube to mix the solutions.
8. Record your observations in the data table below.
9. Dispose of the solutions by flushing them down the drain with copious amounts of water.
10. Use a test tube brush and soapy water to clean the five test tubes and rinse with clean water. Use a paper towel to dry the test tubes as best you can.

***Part D: Benedict’s Solution Test***

***\*\*Note\*\**** Benedict’s solution is a skin and eye irritant. If the Benedict’s solution is spilled, rinse with soap and water and tell your teacher immediately.

1. Look at the five test tubes in the test tube rack in front of you. Make sure to only pick up one test tube at a time and to place it back in the correct place before handling another test tube.
2. Using a clean pipette, add 1.0 mL of vegetable oil to the test tube labeled “oil.”
3. Using a clean pipette, add 1.0 mL of protein solution to the test tube labeled “protein.”
4. Using a clean pipette, add 1.0 mL of starch solution to the test tube labeled “starch.”
5. Using a clean pipette, add 1.0 mL of glucose solution to the test tube labeled “glucose.”
6. Using a clean pipette, add 1.0 mL of distilled water to the test tube labeled “water.”
7. Add 10 drops of Benedict’s solution to each of the test tubes.
8. Place each of the test tubes in the hot water bath for three minutes.
9. After three minutes, remove each test tube from the hot water bath using the test tube tongs. Place each test tube back into the test tube rack.
10. Record your observations in the data table below.
11. Dispose of the solutions by flushing them down the drain with copious amounts of water.
12. Use a test tube brush and soapy water to clean the five test tubes and rinse with clean water. Use a paper towel to dry the test tubes as best you can.

***Data Table***

Indicate a positive test result by placing a “+” in the appropriate box.   
Indicate a negative test result by placing a “-“ in the appropriate box.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Test Tube #1:**  **Oil** | **Test Tube #2:**  **Protein** | **Test Tube #3:**  **Starch** | **Test Tube #4:**  **Glucose** | **Test Tube #5: Water** |
| **Part A:  Biuret’s Reagent** |  |  |  |  |  |
| **Part B:**  **Paper Towel** |  |  |  |  |  |
| **Part C:**  **Lugol’s Iodine** |  |  |  |  |  |
| **Part D:**  **Benedict’s Solution** |  |  |  |  |  |

***Analysis Questions***

1. Which test is used to indicate the presence of a lipid? What color change occurs with the indicator? Which test substance contained lipids?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Which test is used to indicate the presence of a protein? What color change occurs with the indicator? Which test substance contained proteins?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Which test is used to indicate the presence of a complex carbohydrate? What color change occurs with the indicator? Which test substance contained complex carbohydrates?   
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Which test is used to indicate the presence of a simple carbohydrate? What color change occurs with the indicator? Which test substance contained simple carbohydrates?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Why was water used in each test?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Conclusion***

Write a conclusion to this lab by answering each of the prompts below. Remember to use complete sentences with correct spelling, grammar, and punctuation. You may choose to type and email your conclusion to your teacher.

* Restate the purpose of the lab in past tense.
* Briefly describe the procedure used to test for the presence of each of the biomolecules.
* Describe the biological function of each of the biomolecules tested in this lab
* Describe at least one source of error encountered in the lab, how it affected your results, and how it could be corrected
* What did you learn by completing this lab investigation?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Biology I (Honors) Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Activity: Chemistry of Carbohydrates, Lipids, & Proteins Period: \_\_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_\_\_\_

**Objective 1:** Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of organisms.

## Part A – Carbohydrates

There are many different types of carbohydrates. They have been placed into three groups – monosaccharides, disaccharides, and polysaccharides.

Group 1 – Monosaccharides (single molecule sugars)

1. Three examples of monosaccharides are glucose, fructose, and galactose. Below are structural formulas for these three sugars. A structural formula attempts to show the three-dimensional shape of the molecule.   
   *What three elements are present in glucose, fructose, and galactose?*

\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Glucose | Galactose | Fructose |
|  |  |  |

1. Add subscripts to the following to indicate the proper molecular formula. A molecular formula shows the total number of atoms for each element in a molecule.

|  |
| --- |
| Glucose C\_\_\_ H \_\_\_ O \_\_\_ |
| Fructose C\_\_\_ H \_\_\_ O \_\_\_ |
| Galactose C\_\_\_ H \_\_\_ O \_\_\_ |

1. How many **times** (think multiplication) larger is the number of hydrogen atoms than oxygen atoms in a molecule of

Glucose \_\_\_\_\_\_\_\_\_\_

Fructose \_\_\_\_\_\_\_\_\_\_

Galactose \_\_\_\_\_\_\_\_\_\_

1. How many times larger is the number of hydrogen atoms than oxygen atoms in a molecule of water, H2O? \_\_\_\_\_\_\_\_\_\_

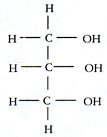
Group 2 – Disaccharides (Oligosaccharides with 2 molecule of sugar)

1. Two monosaccharides sugar molecules can join together chemically to form a larger carbohydrate molecule called a double sugar, or disaccharide. By chemically combining a glucose molecule with a fructose molecule, a double sugar called sucrose is produced. Cut out a glucose and a fructose paper model. Cut along the solid lines only. Attempt to join the two molecules together like puzzle pieces. *Will the glucose and fructose fit together like a puzzle? \_\_\_\_\_\_\_\_\_\_*
2. In order to join the molecules, remove an –OH end from one molecule and an –H end from the other. Cut along the dotted lines. Now fit the glucose and fructose molecules together. The –H and –OH ends that were removed can also fit together to form a molecule. *This new molecule has a molecular formula of \_\_\_\_\_\_\_\_\_\_ and is named \_\_\_\_\_\_\_\_\_\_*.
3. Write the molecular formula for sucrose by adding together the molecular formulas for glucose and fructose (pictured above) and then subtracting water, H2O. C \_\_\_ H \_\_\_ O \_\_\_
4. Different disaccharide molecules can be made by joining other monosaccharides in different combinations. By chemically joining a glucose molecule, a double sugar called maltose is formed. Cut out and join two new glucose molecules. *What must be removed in order for the pieces to fit together like a puzzle? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
5. Write the molecular formula for maltose. C \_\_\_ H \_\_\_ O \_\_\_
6. How does the molecular formula for maltose compare to sucrose? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. How many times larger is the number of hydrogen atoms than oxygen atoms in a disaccharide? \_\_\_\_\_\_\_\_\_\_

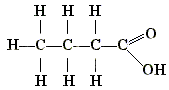
Group 3 – Polysaccharides (many molecule sugars)

1. Just as double sugars were formed from two single sugar molecules, polysaccharides are formed when many single sugars are joined together chemically. Starch, glycogen, and cellulose are the three most common polysaccharides in biology. They consist of long chains of glucose molecules joined together. Construct a starch molecule by joining three glucose molecules. This will represent only a small part of a starch molecule because starch consists of hundreds of glucose molecules.   
   *What must be removed in order for the pieces to fit together like a puzzle? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
2. The molecular formula for a polysaccharide is written as (C6H10O5)n. The *n* equals the number of times the C6H10O5 group is repeated. *How many times larger is the number of hydrogen atoms than oxygen atoms in a polysaccharide? \_\_\_\_\_\_\_\_\_\_\_*

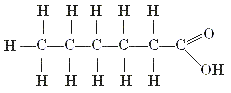
Glycerol



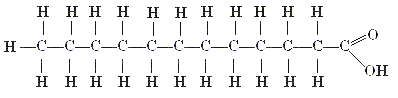
Butyric acid



Caproic acid



Lauric acid



**Part B – Lipids (Fats)**

1. To better understand the chemistry of fats, it is helpful to study first the small molecules (subunits) which join to make up fats. Fat molecules are made up of two different kinds of molecules – glycerol and fatty acids. Examine the structural formula of glycerol.   
   *What elements are present in glycerol? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
2. What is the molecular formula for glycerol? C \_\_\_ H \_\_\_ O \_\_\_
3. As in carbohydrates, are there exactly twice as many hydrogen atoms as oxygen atoms in glycerol? \_\_\_\_\_\_\_\_\_\_
4. The second kind of molecule which is part of a fat is a fatty acid. Many different fatty acids exist, but all are similar in several ways. Butyric acid, caproic acid, and lauric acid are examples of fatty acids. Examine the structural formulas for these three fatty acids. *What elements are present in all fatty acids?* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. What is the molecular formula for

Butyric acid C \_\_\_ H \_\_\_ O \_\_\_

Caproic acid C \_\_\_ H \_\_\_ O \_\_\_

Lauric acid C \_\_\_ H \_\_\_ O \_\_\_

1. Are there exactly twice as many hydrogen atoms as oxygen atoms in fatty acids? \_\_\_\_\_\_\_\_\_\_
2. What pattern does appear in the fatty acid molecules regarding the number of oxygen atoms? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Note the end of the butyric acid containing the oxygen atoms. This special end arrangement of carbon, hydrogen, and oxygen is called a carboxyl group  . Is the carboxyl group present in all fatty acids? \_\_\_\_\_\_\_\_\_\_
4. Is the carboxyl group present in glycerol? \_\_\_\_\_\_\_\_\_\_
5. A lipid molecule consists of one glycerol and three fatty acids joined together. Cut out the glycerol and fatty acid paper model molecules. Cut along the solid lines only. *Will the fat molecule fit together as pieces in a puzzle? \_\_\_\_\_\_\_\_\_\_*
6. What has to be removed in order for the pieces to fit together as a puzzle? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Remove these and construct the fat molecule. How many glycerol molecules are needed to form one fat molecule? \_\_\_\_\_ How many fatty acid molecules are needed to form one fat molecule? \_\_\_\_\_
8. What chemical substance is formed when the –H and –OH ends are joined? \_\_\_\_\_\_\_\_\_\_
9. How many of these molecules are formed when one fat molecule is produced? \_\_\_\_\_\_\_\_\_\_

## Part C – Proteins

1. Proteins are complex molecules made up of simpler building blocks called subunits. The subunits which make up protein molecules are called amino acids. Examine the structural formulas of the four amino acids represented here.   
   *What elements are present in all four amino acids? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

|  |  |  |  |
| --- | --- | --- | --- |
| Glycine | Alanine | Threonine | Valine |
| http://www.chem.purdue.edu/gchelp/molecules/glycine.gif | http://www.chem.purdue.edu/gchelp/molecules/alanin.gif | http://www.chem.purdue.edu/gchelp/molecules/thr.gif | http://www.chem.purdue.edu/gchelp/molecules/valine.gif |

1. What is the molecular formula for the amino acid

Glycine C \_\_\_ H \_\_\_ O \_\_\_ N \_\_\_

Alanine C \_\_\_ H \_\_\_ O \_\_\_ N \_\_\_

Threonine C \_\_\_ H \_\_\_ O \_\_\_ N \_\_\_

Valine C \_\_\_ H \_\_\_ O \_\_\_ N \_\_\_

1. Are there exactly twice as many hydrogen atoms as oxygen atoms in amino acids? \_\_\_\_\_\_\_\_\_\_
2. What end arrangement of atoms is present in amino acids as well as fatty acids? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Another end arrangement in all amino acids consists of a nitrogen atom and two hydrogen atoms. This group is called an amino group  . Do structural formulas for all amino acids have amino groups? \_\_\_\_\_\_\_\_\_\_
4. Protein is composed of many amino acids joined together chemically. Cut out the four amino acid paper models. Cut along the solid lines only. *Will the protein molecule fit together like pieces of a puzzle? \_\_\_\_\_\_\_\_\_\_*
5. What has to be removed in order for the pieces to fit together as a puzzle? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Remove the necessary ends and join the four amino acids together in this order: valine, threonine, alanine, glycine.
7. What chemical substance is formed when the leftover –H and –OH ends join? \_\_\_\_\_\_\_\_\_\_
8. How many molecules of water are formed when four amino acids join together? \_\_\_\_\_\_\_\_\_\_
9. Other combinations of amino acids result in the formation of different proteins. Construct a protein different from the one above. List the order of the amino acids in your new protein. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Analysis Questions

1. What is the molecular formula for each of the following:

Monosaccharides \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

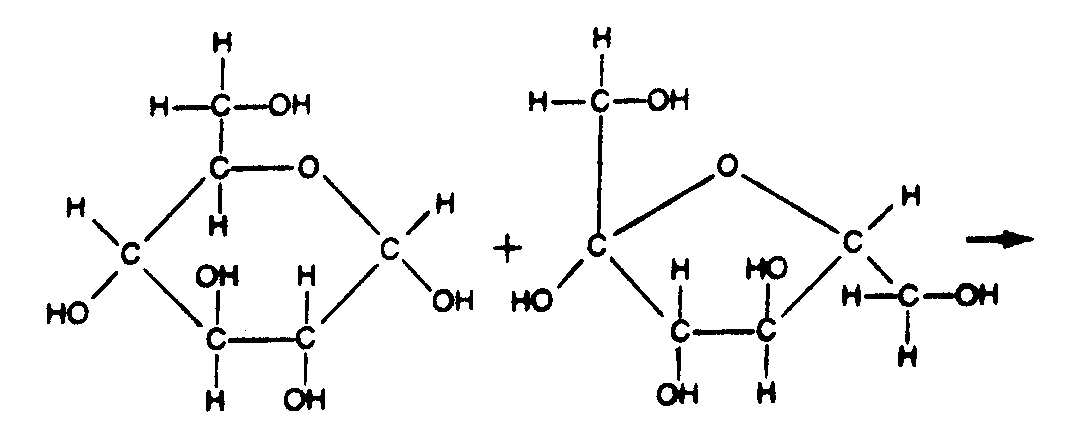
Disaccharides \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Polysaccharides \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. How might one lipid differ from another? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How might one protein differ from another? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What small molecules (monomers) are used to form large carbohydrates? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What small molecules (monomers) are used to form proteins? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. What small molecules (monomers) are used to form lipids? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. When these monomers combine to form macromolecules, what must be removed from the ends of the subunits in order for them to be able to combine? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Place an “X” in each column that applies.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Carbohydrates** | **Lipids** | **Proteins** |
| Carbon present |  |  |  |
| Hydrogen present |  |  |  |
| Oxygen present |  |  |  |
| Nitrogen present |  |  |  |
| Contains exactly twice the amount of hydrogen as oxygen |  |  |  |
| Has a carboxyl group |  |  |  |
| Has an amino group |  |  |  |

1. **Challenge Question:** Molecules of glucose and fructose are given here. Complete the chemical reaction.



1. **Challenge Question:** A disaccharide is shown below. Complete the chemical reaction.

|  |  |
| --- | --- |
|  | **+ H2O 🡪** |

